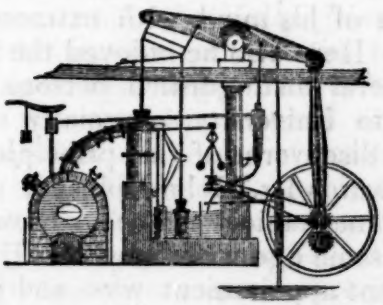
The Mechanic.

FEBRUARY, 1834.

JAMES WATT.



James Watt was born at Greenock on the 19th of January, 1736. His father was a merchant, and also one of the magistrates of that town. He received the rudiments of his education in his native place; but his health being even then extremely delicate, as it continued to be to the end of his life, his attendance at school was not always very regular. He amply made up, however, for what he lost in this way, by the diligence with which he pursued his studies at home, where without any assistance he succeeded at a very early age in making considerable proficiency in various branches of knowledge. Even at this time his favorite study is said to have been mechanical science, to a love of which he was probably in some degree led by the example of his grandfather and his uncle, both of whom had been teachers of the mathematics, and had left a considerable reputation for learning and ability in that department. Young Watt, however, was not indebt-

ed to any instructions of theirs for his own acquirements in science, the former having died two years before, and the latter the year after, he was born. At the age of eighteen he was sent to London to be apprenticed to a maker of mathematical instruments; but in little more than a year the state of his health forced him to return to Scotland; and he never received any further instruction in his profession. A year or two after this, however, a visit which he paid to some relations in Glasgow, suggested to him the plan of attempting to establish himself in that city, in the line for which he had been educated. In 1757, accordingly, he removed thither, and was immediately appointed mathematical instrument maker to the College. In this situation he remained for some years; during which, notwithstanding almost constant ill health, he continued both to prosecute his profession, and to labor in the general cultivation of his mind, with extraordinary ardor and perseverance. Here also he enjoyed the friendship and intimacy of several distinguished persons who were then members of the University, especially of the celebrated Dr. Black, the discoverer of the principle of latent heat, and Mr. (afterwards Dr.) John Robison, so well known by his treatises on mechanical science, who was then a student and about the same age with himself. Honorable, however, as his present appointment was and important as were many of the advantages to which it introduced him, he probably did not find it a very lucrative one; and therefore, in 1763, when about to marry, he removed from his apartments in the University to a house in the city, and entered upon the profession of a general engineer.

For this his genius and scientific attainments admirably qualified him. Accordingly, he soon acquired a high reputation, and was extensively employed in making surveys and estimates for canals, harbors, bridges, and other public works. His advice and assistance were indeed sought for in almost all the important improvements of this description which were now uudertaken or proposed in his native country. But another pursuit, in which he had been for some time privately engaged, was destined ere long, to withdraw him from this line of exertion, and to occupy his whole mind with an object still more worthy of its extraordinary powers.

While yet residing in the College his attention had been directed to the employment of steam as a mechanical agent, by some speculations of his friend Mr. Robison, with regard to the practicability of applying it to the movement of wheel carriages; and he had also himself made some experiments with Papin's digester, with the view of ascertaining its expansive force. He had not prosecuted the inquiry, however, so far as to have arrived at any determinate result, when, in the winter of 1763–4, a small model of Newcomen's engine was sent to him by the Professor of Natural Philosophy to be repaired, and fitted for exhibition in the class. The examination of this model set Watt upon thinking anew, and with more interest than ever, on the powers of steam.

The first thing that attracted his attention about the machine before him, the cylinder of which was only of two inches in diameter, while the piston descended through six inches, was the insufficiency of the boiler, although proportionably a good deal larger than in the working engines, to supply the requisite quantity of steam for the creation of the vacuum. In order to remedy this defect, he was obliged, in repairing the model, to diminish the column of water to be raised; in other words, to give the piston less to do, in compensation for its having to descend, not through a perfect vacuum, but in opposition to a considerable residue of undisplaced air. He also soon discovered the reason why in this instance, the steam sent up from the boiler was not sufficient to fill the cylinder. In the first place, this containing vessel, being made, not of cast iron, as in the larger engines, but of brass, abstracted more of the heat from the steam, and so weakened its expansion; and secondly, it exposed a much larger surface to the steam, in proportion to its capacity, than the cylinders of the larger engines did, and this operated still more strongly to produce the same effect. Led by the former of these considerations, he made some experiments in the first instance, with the view of discovering some other material whereof to form the cylinder of the engine, which should be less objectionable than either brass or cast iron; and he proposed to substitute wood, soaked in oil, and baked dry. But his speculations soon took a much wider scope; and, struck with the radical imperfections of the atmospheric engine, he began to turn in

his mind the possibility of employing steam in mechanics, in some new manner which should enable it to operate with much more powerful effect. This idea having got possession of him, he engaged in an extensive course of experiments, for the purpose of ascertaining as many facts as possible with regard to the properties of steam; and the pains he took in this investigation were rewarded with several valuable discoveries. The rapidity with which water evaporates, he found, for instance, depended simply upon the quantity of heat which was made to enter it; and this again on the extent of the surface exposed to the fire. He also ascertained the quantity of coals necessary for the evaporation of any given quantity of water, the heat at which water boils under various pressures, and many other particulars of a similar kind, which had never before been accurately determined.

Thus prepared by a complete knowledge of the properties of the agent with which he had to work, he next proceeded to take into consideration, with a view to their amendment, what he deemed the two grand defects of Newcomen's engine. The first of these was the necessity arising from the method employed to concentrate the steam, of cooling the cylinder before every stroke of the piston, by the water injected into it. On this account, a much more powerful application of heat than would otherwise have been requisite, was demanded for the purpose of again heating that vessel, when it was to be refilled with steam. In fact, Watt ascertained that there was thus occasioned, in the feeding of the machine, a waste of not less than three-fourths of the whole fuel employed. If the cylinder, instead of being thus cooled for every stroke of the piston, could be kept permanently hot, a fourth part of the heat which had been hitherto applied, would be found to be sufficient to produce steam enough to fill it. How, then, was this desideratum to be attained? De Caus had proposed to effect the condensation of the steam by actually removing the furnace from under the boiler before every stroke of the piston; but this, in a working engine, evidently would have been found quite impracticable. Savery, the first who really constructed a working engine, and whose arrangements, as we have already remarked, all showed a very superior ingenuity, employed the method of throwing cold water over the outside of the vessel con-

taining his steam—a perfectly manageable process, but at the same time a very wasteful one; inasmuch as, every time it was repeated, it cooled not only the steam, but the vessel also, which, therefore, had again to be heated, by a large expenditure of fuel, before the steam could be reproduced. Newcomen's method of injecting the water into the cylinder, was a considerable improvement on this; but it was still objectionable on the same ground, though not to the same degree: it still cooled not only the steam, on which it was desired to produce that effect, but also the cylinder itself, which, as the vessel in which more steam was to be immediately manufactured, it was so important to keep hot. It was also a very serious objection to this last-mentioned plan, that the injected water itself, from the heat of the place into which it was thrown, was very apt to be partly converted into steam; and the more cold water was used, the more considerable did this creation of new steam become. In fact, in the best of Newcomen's engines, the perfection of the vacuum was so greatly impaired from this cause, that the resistance experienced by the piston in its descent, was found to amount to about a fourth part of the whole atmospheric pressure by which it was carried down, or, in other words, the working power of the machine was thereby diminished one-fourth.

After reflecting some time upon all this, it at last occurred to Watt to consider whether it might not be possible, instead of continuing to condense the steam in the cylinder, to contrive a method of drawing it off, to undergo that operation in some other vessel. This fortunate idea having presented itself to his thoughts, it was not very long before his ingenuity also suggested to him the means of realizing it. In the course of one or two days, according to his own account, he had all the necessary apparatus arranged in his mind. The plan which he devised, indeed, was an extremely simple one, and on that account the more beautiful. He proposed to establish a communication by an open pipe between the cylinder and another vessel, the consequence of which evidently would be, that when the steam was admitted into the former, it would flow into this latter so as to fill it also. If then the portion in the latter vessel only should be subjected to a condensing process, by being brought into contact with cold water,

or any other convenient means, what would follow? Why, a vacuum would be produced here—into that, as a vent, more steam would immediately rush from the cylinder—that likewise would be condensed—and so the process would go on till all the steam had left the cylinder, and a perfect vacuum had been effected in that vessel, without so much as a drop of cold water having touched or entered it. The separate vessel alone, or the Condenser, as Watt called it, would be cooled by the water used to condense the steam—and that, instead of being an evil, manifestly tended to promote and quicken the condensation. When Watt reduced these views to the test of experiment, he found the result to answer his most sanguine expectations. The cylinder, although emptied of its steam for every stroke of the piston as before, was now constantly kept at the same temperature with the steam, (or 212° Fahrenheit); and the consequence was, that one fourth of the fuel formerly required, sufficed to feed the engine. But besides this most important saving in the expense of maintaining the engine, its power was greatly increased by the more perfect vacuum produced by the new construction, in which the condensing water, being no longer admitted within the cylinder, could not, as before, create new steam there while displacing the old. The first method which Watt adopted of cooling the steam in the condenser, was to keep that vessel surrounded by cold water—considering it as an objection to the admission of the water into its interior, that it might be difficult in that case to convey it away as fast as it would accumulate. But he found that the condensation was not effected in this manner with so much rapidity as was desirable. It was necessary for him, too, at any rate, to employ a pump attached to the condenser, in order to draw off both the small quantity of water deposited by the cooled steam, and the air unavoidably introduced by the same element—either of which, if allowed to accumulate, would have impaired the perfect vacuum necessary to attract the steam from the cylinder. He therefore determined eventually to admit also the additional quantity of water required for the business of condensation, and merely to employ a larger and more powerful pump to carry off the whole.

Such, then, was the remedy by which the genius of Watt effectually cured the first and most serious defect of the

old apparatus. In carrying his ideas into execution, he encountered, as was to be expected, many difficulties, arising principally from the impossibility of realizing theoretical perfection of structure with such materials as human art is obliged to work with; but his ingenuity and perseverance overcame every obstacle. One of the things which cost him the greatest trouble was, how to fit the piston so exactly to the cylinder as without affecting the freedom of its motion, to prevent the passage of the air between the two. In the old engine, this end had been attained by covering the piston with a small quantity of water, the dripping down of which into the space below, where it merely mixed with the stream introduced to effect the condensation, was of little or no consequence. But in the new construction, the superiority of which consisted in keeping this receptacle for the steam always both hot and dry, such an effusion of moisture, although only in very small quantities, would have occasioned material inconvenience. The air alone, besides, which in the old engine followed the piston in its descent, acted with considerable effect in cooling the lower part of the cylinder. His attempts to overcome this difficulty, while they succeeded in that object, conducted Watt also to another improvement, which effected the complete removal of what we have called the second radical imperfection of Newcomen's engine, namely, its non-employment, for a moving power, of the expansive force of the steam. The effectual way, it occurred to him, of preventing any air from escaping into the part of the cylinder below the piston, would be to dispense with the use of that element above the piston, and to substitute there likewise the same contrivance as below, of alternate steam and a vacuum. This was of course to be accomplished by opening communications from the upper part of the cylinder to the boiler on the one hand, and the condenser on the other, and forming it at the same time into an air-tight chamber, by means of a cover, with only a hole in it to admit the rod or shank of the piston, which might, besides, without impeding its freedom of action, be padded with hemp, the more completely to exclude the air. It was so contrived, accordingly, by a proper arrangement of the cocks and the machinery connected with them, that, while there was a vacuum in one end of the cylinder, there should be an admission of steam into the

other; and the steam so admitted now served, not only by its susceptibility of sudden condensation, to create the vacuum, but also by its expansive force, to impel the piston. Steam, in fact, was now restored to be, what it had been in the early attempts to use it as a mechanical agent, the moving power of the engine; but its efficiency in this capacity was for the first time, both taken full advantage of, by means of contrivances properly arranged for that end, and combined with, and aided by, its other equally valuable property, which had alone been called into action in the more recent machines.

These were the great improvements which Watt introduced in what may be called the principle of the steam-engine, or in other words, in the manner of using and applying the steam. They constitute, therefore, the grounds of his claim to be regarded as the true author of the conquest that has at last been obtained by man over this powerful element. But original and comprehensive as were the views out of which these fundamental inventions arose, the exquisite and inexhaustible ingenuity which the engine, as finally perfected by him, displays in every part of its subordinate mechanism, is calculated to strike us perhaps with scarcely less admiration. It forms undoubtedly the best exemplification that has ever been afforded, of the number and diversity of services which a piece of machinery may be made to render to itself by means solely of the various applications of its first moving power, when that has once been called into action. Of these contrivances, however, we can notice only one or two, by way of specimen. Perhaps the most singular is that called the *governor*. This consists of an upright spindle, which is kept constantly turning, by being connected with a certain part of the machinery, and from which two balls are suspended in opposite directions by rods, attached by joints, somewhat in the manner of the legs of a pair of tongs. As long as the motion of the engine is uniform, that of the spindle is so likewise, and the balls continue steadily revolving at the same distance from each other. But as soon as any alteration in the action of the piston takes place, the balls, if it has become more rapid, fly farther apart under the influence of the increased centrifugal force which actuates them—or approach nearer to each other in the opposite circumstances. This alone would

have served to indicate the state of matters to the eye; but Watt was not to be so satisfied. He connected the rods with a valve in the tube by which the steam is admitted to the cylinder from the boiler, in such a way, that as they retreat from each other they gradually narrow the opening which is so guarded, or enlarge it as they tend to collapse; thus diminishing the supply of steam when the engine is going too fast, and, when it is not going fast enough, enabling it to regain its proper speed by allowing it an increase of aliment. Again the constant supply of a sufficiency of water to the boiler is secured by an equally simple provision, namely, by a *float* resting on the surface of the water, which, as soon as it is carried down by the consumption of the water, to a certain point, opens a valve and admits more. And so on through all the different parts of the apparatus, the various wonders of which cannot be better summed up than in the forcible and gaphic language of a recent writer:—'In the present perfect state of the engine it appears a thing almost endowed with intelligence. It regulates with perfect accuracy and uniformity the *number of its strokes* in a given time, *counting* or *recording* them moreover, to tell how much work it has done, as a clock records the beats of its pendulum;—it regulates the *quantity of steam* admitted to work;—the *briskness of the fire;*—the *supply of water* to the boiler;—the *supply of coals* to the fire;—it *opens and shuts its valves* with absolute precision as to time and manner;—it *oils its joints;*—it *takes out any air* which may accidentally enter into parts which should be vacuous; and when anything goes wrong which it cannot of itself rectify, it *warns its attendants* by ringing a bell; yet with all these talents and qualities, and even when exerting the power of six hundred horses, it is obedient to the hand of a child;—its aliment is coal, wood, charcoal, or other combustible;—it consumes none while idle,—it never tires, and wants no sleep;—it is not subject to malady, when originally well made, and only refuses to work when worn out with age; it is equally active in all climates, and will do work of any kind;—it is a water-pumper, a miner, a sailor, a cotton-spinner, a weaver, a blacksmith, a miller, &c. &c.; and a small engine, in the character of a *steam-poney*, may be seen dragging after it on a railroad a hundred tons of merchandize, or a regi-

ment of soldiers, with greater speed than that of our fleetest coaches. It is the king of machines, and a permanent realization of the *Genii* of Eastern fable, whose supernatural powers were occasionally at the command of man.'

[CONCLUDED IN OUR NEXT.]

[From the London Mechanics' Magazine.]

IMPROVED DOUBLE ACTING CLAMS* FOR A LATHE.

SIR,—I trust that the general utility of which the following improvement in double-acting clams promises to be productive to a large class of your readers, will be deemed a sufficient excuse for my requesting you to bring it under their notice.

Fig. 1.

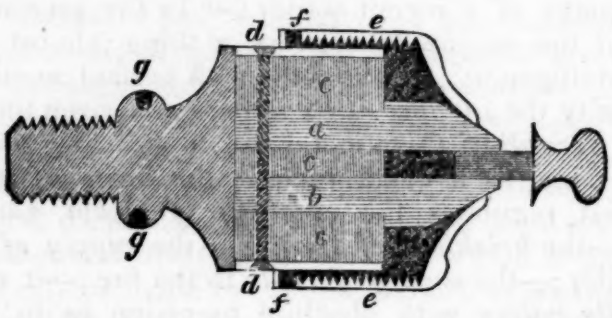


Fig. 2.

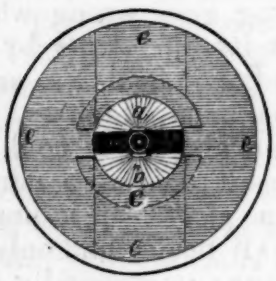


Fig. 3.

Fig. 1 is a section of the clams. *a b* are the two tongues acting in an oblong space *ccc*, being adjusted to the size of the work by the screws, *dd*. A ferule *ee* is screwed all along on the inside, which is screwed upon the

* We suppose *Clamps* would be more correct.—EDS. MEC.

body of the clams at the point *e*, and by screwing or unscrewing holds or loosens the work by acting upon the inclined face of the tongues. Fig. 3 is the kind of key by which the ferule is screwed or unscrewed at the point *f*, and the tool screwed into the lathe at *g*. Fig. 2 is a front-view of the clams.

I have lately, with considerable trouble, tried four different kinds of clams, but have found none to answer like the present, either for simplicity of workmanship, or for smallness (the size being only one-fourth of others which take only the same sized work,) or for the steadiness and nicety with which they turn.

I am, Sir,

Your obedient servant,

ARCHIBALD HORN.

INVENTION OF THE SAFETY LAMP.

THIS lamp, by means of which hundreds of lives have been preserved, was invented in the autumn of 1815. Sir Humphry Davy, the inventor, was led to the consideration of this subject, by an application from Dr. Gray, now Bishop of Bristol, the chairman of a society established in 1813, at Bishop-Wearmouth, to consider and promote the means of preventing accidents by fire in coal-pits. Being then in Scotland, he visited the mines on his return southward, and was supplied with specimens of fire-damp, which, on reaching London, he proceeded to examine and analyze. He soon discovered that the carburetted hydrogen gas, called fire-damp by the miners, would not explode when mixed with less than six, or more than fourteen, times its volume of air; and further, that the explosive mixture could not be fired in tubes of small diameters and proportionate lengths. Gradually diminishing these, he arrived at the conclusion that a tissue of wire in which the meshes do not exceed a certain small diameter, which may be considered as the ultimate limit of a series of such tubes, is impervious to the inflamed air; and that a lamp covered with such tissue may be used with perfect safety, even in an explosive mixture which takes fire and burns within the cage,

securely cut off from the power of doing harm. Thus, when the atmosphere is so impure that the flame of a lamp itself cannot be maintained, the Davy still supplies light to the miner, and turns his worst enemy into an obedient servant. This invention, the certain source of large profit, he presented with characteristic liberality to the public. The words are preserved in which, when pressed to secure to himself the benefit of a patent, he declined to do so, in conformity with the high-minded resolution which he formed, upon acquiring independent wealth, or never making his scientific eminence subservient to gain. 'I have enough for all my views and purposes; more wealth might be troublesome, and distract my attention from those pursuits in which I delight. More wealth could not increase my fame or happiness. It might undoubtedly enable me to put four horses to my carriage; but what would it avail me to have it said that Sir Humphry drives his carriage and four?'—Gallery of Portraits.

ADVANTAGE OF A LITTLE KNOWLEDGE.

The mysteries of magnetism should be unfolded to the sailor, above all men, since he is the one of all others whose safety depends on its phenomena. He should be told that on electro-magnetic principles he would materially influence the march of the needle by wiping the glass which screens it—especially with silk. It is some years since a fact was communicated to me, which may be adduced in illustration. It was that of a ship which arrived at Liverpool, after having been for several weeks the sport of winds and waves. The mariner's compass having been washed overboard in a storm, their voyage was dreary and procrastinated—much caution being necessary, and despite of which, their fate, but for a fortuitous circumstance, might have been inevitably sealed. Now, had the simple fact of the extreme ease with which a mariner's needle might be made, been known to any on board, the peril might have been avoided. A sewing needle, or the blade of a penknife, being held in an upright posture, and struck by a hammer, and subsequently floated by cork on water, or

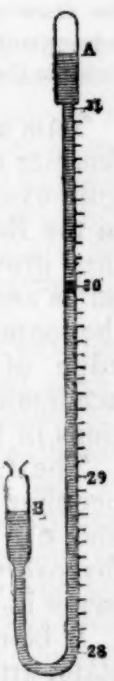
suspended by a thread without iron, would become a magnetic needle, and point north and south; or the end of a poker held vertically and passed over its surface from one extreme to the other, would impart magnetism, which, if the needle be of steel, would be of a permanent character.

[For the Mechanic.]

NEW PISTON BAROMETER.

MESSRS. EDITORS:—In the course of my cogitations, it is frequently the case, that before I find the object of my research, I stumble upon something else, which rewards me, in part at least, for my trouble. The instrument I am about to describe, is the result of one of those accidental hits. Although it appears to have some good qualities, yet it may, for aught I know, have bad ones enough to condemn it; still, I think it of sufficient importance to be made known to the public.

DESCRIPTION.—A glass tube is to be made in the form represented in the annexed figure, having an enlarged part at each end, which is to be filled with mercury, in the usual manner. Its length must be such, as to allow the distance between the two surfaces of mercury A and B, to vary from 28 to 31 inches; leaving about two inches at each end unoccupied by that fluid.



A piston is represented at 30, which may be formed of a bubble of air, or other suitable substance. Now it is evident that the piston may be made to move any distance we please, by giving to the tube the proper proportions. If, for instance, the large parts of the tube are one inch in diameter, and the small part in which the piston moves only one tenth of an inch, the quantity of mercury contained in a given height in the large part will be a hundred times as great as that contained in the same height in the small part: or in other words, if the surface of the mercury in the large part of the tube should move a hundredth part of an inch, the piston in

the small part will move an inch; and for the alteration of an inch in one of the large parts, the piston would pass through one hundred inches in the small part of the tube.

It appears to me, that this would make a delicate instrument, capable of detecting very small variations in the atmospheric pressure, and be applicable to purposes to which the common barometer is not. The tube can be bent into a spiral or other circuitous form, when a very great range of the piston is required for nice purposes.

Boston, Feb. 4th, 1834. PHILO.

CAOUTCHOUC.

We have extracted such parts from an article in the Tracts and Lyceum on this subject, as appear to us of the most importance. Some passages are omitted, in which the reasoning is unphilosophical, or, to say the least, liable to be misunderstood. The editor of the Tracts expresses our views, when he says—'It is with peculiar satisfaction that we present our readers with the following valuable essay on the useful purposes to which India Rubber may be applied, in domestic economy. In point of importance, the discovery of the process by which this substance has been made subservient to the wants and necessities of mankind, is an extraordinary event in the history of the arts.'

This article, which has been known to the public by the familiar name of India Rubber, is a white milky juice or gum exuded from certain plants, found abundantly in Para, in the Brazils, in Quito, in Asia and several other places; they grow so extensively in some places that hundreds of miles are covered with them; therefore there is no fear of the material falling short of the demand. The first knowledge of it in Europe was acquired from some French academicians, who were sent out for astronomical observations in 1735.

The Caoutchouc has great elasticity, and possesses the peculiar property of being impervious to air and water; and can be applied to many valuable uses. Since this discovery, many experiments, at a great expense, have been made in England; and its value is highly appreciated.

It being known that its original condition was the fluid state, attempts were made to liquefy it, for the purpose of

applying it to other uses; solvents were discovered, such as the essential oil of coal tar, the oil of sassafras, and the essential oil of turpentine; it was found to be soluble in fat oils, as of almonds and olives. After this was known, it was applied to cloth, canvass, and boots, for protection against the weather. These attempts were, however, but partially successful; for it was found that the solvent deprived it, in part, of its tenacity to adhere; and, instead of a firm but yielding tension, it converted it into a glutinous matter, whose adhesive properties were weakened on the application of moderate heat, or even by exposure to common air in warm weather. This rendered it inconvenient and useless for many purposes to which it was desirable to apply it; and it was not till the establishment of the India Rubber Company at Roxbury, in this state, an association of gentlemen who have ample means to carry their plans into operation, that a mode was found out, through the intervention of expensive machinery, of reducing this peculiar substance from the state in which it is imported, to a liquid, and again restoring it, after it has been applied to the purposes required, to its original tenseness and elasticity, without impairing any of the original qualities for which it is distinguished. Cloth may be covered by this new process, and present a smooth and pliable surface, to which it adheres with all its original tenacity; so much so, that seams of garments, or pieces of cloth united together with it, cannot be separated; and even the material itself, which is subjected to the application, seems to acquire additional strength and durability. The same effect is produced on other substances; and the *modus operandi* by which this result is procured, seems to have been completely successful.

The purposes to which the *Caoutchouc* can be advantageously applied, are numerous, and have opened a new field for industry and enterprise. A flexible substance, capable of confining atmospheric air, and of sufficient strength to sustain an external pressure of more than six atmospheres, as this has been proved to be by actual experiment, is a desideratum in the arts, which science in the various phases of its progress had not invented, nor philosophy, till now, obtained from the prolific materials which nature has supplied for the experiments of her inexhausted laboratory. Manufactured leather has heretofore supplied,

to some extent, the want of such material; but it is surpassed by India Rubber cloth in flexibility, strength, and its capacity to retain air and fluids. Experiments have been made with the fire-engine hose, usually made of the firmest leather; and the hydraulic pressure which burst the leathern hose in pieces, it sustained without any appearance of its parts being disunited.

From these general remarks on *Caoutchouc*, and its application to cloth, we proceed to enumerate some of the specific purposes for which it has been used; without mentioning wearing apparel, over-shoes and boots, by which we are furnished with complete protection from the severity of our northern clime.

The first we shall mention on the list of useful improvements, is the SEAMEN'S BED, OR FLOATING MATTRASS, invented by Mr. Israel Martin. The object of the inventor was, to furnish an article which might be used for the preservation of human life, when disasters happen at sea, or on rivers. For this purpose this mattrass is well calculated. It is simple in its construction, being made like the common mattrass, and enclosed in a covering of India Rubber cloth. As the seams of the mattrass are closed with *Caoutchouc*, a portion of atmospheric air is enclosed with the material which is used to fill it. As this air cannot escape from its 'prison house,' and must remain there as long as its covering continues whole, it adds to the buoyancy of the mattrass, in proportion as the specific gravity of air is less than that of water. An experiment was tried in the Navy Yard at Charlestown, in the presence of Commodore Elliot; and one of them measuring on its surface five feet, ten inches, by three feet, sustained the weight of four hundred pounds, without sinking to the surface of the water; and it was the opinion of those who witnessed it, that it would have sustained double that weight.* The only difficulty which presents itself is, that the outside covering may, by any means, become perforated, and give the air a chance to escape. To obviate danger from this cause, a quantity of cork is placed in the mattrass sufficient to support a person in the water; thus, as a life preserver, in cases of accidents at sea, it can be depended upon.

* If the mattrass was 8·57 inches thick, its bulk would equal that of 800 lbs. of sea water.—EDS. MEC.

There are other advantages pertaining to the *seamen's mattrass*, which nautical men will know how to appreciate. It is well known that animal material, such as hair and feathers, absorbs moisture, and retains infectious matter, which many diseases throw out from the animal system in a degree which renders it necessary that beds made of such material should be destroyed. It is known that vegetable material does not imbibe this poisonous effluvia in the same degree; hence these mattrasses are made entirely of *vegetable* material, and would not communicate contagious diseases, even if there were not another preventive; which is, no moisture can penetrate the *Caoutchouc* covering, and its outer surface is alone susceptible of becoming corrupted by the diseased parts which come in contact with it. As this surface is also a vegetable material, there is little danger of its retaining any animal poison that may be deposited upon it; and as it can be so easily fumigated and cleansed, the chance of its holding any deleterious properties is entirely removed. Seamen who visit tropical climates suffer much by the use of improper beds; and it is said that in Turkey, the fear of taking the plague by contagion is so great, that beds are not allowed to be used on board of vessels. This article combines health and safety; and promises to mariners great and extensive usefulness.

As an appendage to the mattrass, is the India Rubber Cloth Pillow, which, in all but its size and form, is like the seamen's mattrass; is made of the same material, and possesses the same degree of buoyancy. The principal design of it is, to furnish a smaller and more convenient life-preserver, to be used on a sudden emergency. Its form is circular, with a hole in the centre, representing a rim of about ten inches in width. The sides are doubled together, as if the two parts were united by hinges, resembling a half moon. In this way it is used for the bed; but when danger is apprehended, the head and arms are thrust through it, and it forms a girdle round the body, capable of supporting a man in the water. This, with the *air belt*, a similar contrivance, though smaller and merely buckled around the body, is so useful and safe, that we wonder much that those who are fond of exposing themselves to the dangers of water parties in small frail open wherries, do not procure them for protection against accidents which are occurring year after year in our harbor. Who does not remember when, but a few short months since, the boat

Bunker Hill foundered in a squall, and eight human beings, all active members of society, made their graves in the ocean, almost in sight of their own dwellings? It is known that on board that boat there was nothing sufficiently buoyant to support one person. Had they been provided with any of these articles, in all probability they would have been rescued; for aid was at hand, could they but have supported themselves for a few brief moments.

THE FIRE ENGINE HOSE.—Caoutchouc cloth has been successfully used in making this article. Three lamina or thicknesses of cloth will sustain a pressure of one hundred pounds to the square inch: it is superior in strength to leather of the usual thickness, a more flexible substance, and can be more conveniently handled. The leathern hose is never perfectly free from leaks; consequently, there is a waste of water in using it; but the hose made with Caoutchouc cloth is always tight. The former becomes saturated with water, and requires a great expense of time and labor in drying; the latter avoids this difficulty, and can be stowed away immediately after it has been used, without injury. It is getting into extensive use, and its advantages are so apparent, that it must soon supersede the use of the leathern hose altogether.

THE PORTABLE BATHING TUB is a simple but useful contrivance, which every family should be supplied with. It is made of Caoutchouc or India Rubber cloth, suspended from a frame work from five to six feet in length, supported by legs which cross each other transversely, united by a pin or axle, so that it can be closed or opened at pleasure. The cloth sinks down from the frame work like a bag, sufficiently capacious to receive the whole body. When not in use, it is shut up, or closed; and as it then takes up but little space, it can be put in the corner of the room, or in any convenient place till it is again wanted.

MACHINERY BANDS.—It has recently been discovered that the Caoutchouc cloth can be advantageously used for bands for machinery. Its adhesive tendency prevents it from slipping on the revolving cylinders as leather is apt to do. It is also much cheaper than leather, and equally as durable; is always flexible; does not become dry and stiff like leather; and, as far as experiments have been made, it has proved a good substitute for it.

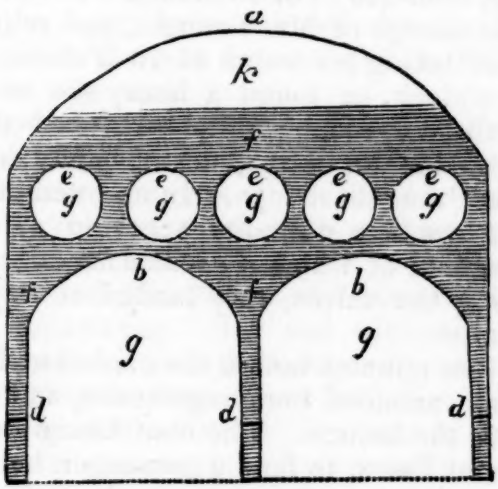
This cloth is also valuable for *coverings for wagons*, as it effectually excludes water; and for *Mail bags*, to preserve

letters and papers from injury when accidentally exposed to wet. This entitles it to the notice of Government, as an improvement that is likely to be of great benefit to the public.

There are doubtless many other uses to which the *Caoutchouc* will be applied when the public attention shall have been sufficiently directed to it. We have mentioned some of the most prominent articles for which it has already been used, in order to show its utility.

[Compiled for the Mechanic.]

STEAM BOAT NEW ENGLAND.



REFERENCES.—*a*, is the outer shell of the boiler; *bb*, are the arches, or main furnace flues; *ddd*, are the water legs; *eeeee*, are the return flues; *fff*, represent the water in the boiler; *ggggg*, are the passages for the fire through the flues; *k*, is the space for steam above the water.

THE cause of the explosion of the boilers of this boat, has for some time been under the consideration of a committee of scientific gentlemen, appointed for this purpose. Their design has been, to procure such evidence as would decide, whether the accident should be attributed to the neglect and carelessness of the engineers, or to causes beyond their control. The report, being somewhat long, will not permit us to copy it entire; but we shall attempt

to give such a synopsis of the evidence, as will place the subject in its proper light before our readers.

The witnesses examined by the committee were, Alexander Marshall, Engineer; Robert Younger, Assistant Engineer; William Vail, Pilot; Giles Farnham and Edwin Bell, Firemen; Isaac Seymour, Mate; Roswell Potter and Adam Hall, Engineers; Henry Waterman, Jr. Captain; and Mr. Samuel Hayden.

Mr. Marshall was chief Engineer of the New England at the time of the accident, on the 8th of October last. She started from New York at 4 o'clock, P. M., on that day, with a light pressure of steam; the engine having started cold, the steam did not increase till they had proceeded as far as Hurl-gate. He states that the average pressure used, on the passage, was from 10 to 12 inches. The steam rose after starting, from 8 to 14 or 16 inches. At 7, P. M., he left the Engine in charge of Mr. Younger, and retired to rest, with a view of taking his watch at 10 o'clock. On being called at 10 o'clock, he found a heavy sea in the sound, and by Captain Waterman's orders, reduced the steam to 8 or 9 inches. He was obliged to stop before arriving in the river, to adjust the wheel-rope. In an attempt to gain the wharf at Saybrook, a difficulty occurred with the lifting valves, on account of which it became necessary to anchor. After repairing the valves, they landed at Saybrook, and also at Lyme.

Three or four minutes before the explosion, he went into the fire-room, examined the guage-cocks, and found sufficient water in the boilers. The boat being stopped about two minutes, at Essex, to land a passenger, he took hold of the pulley to raise the safety-valve, and at that instant the explosion took place.

With regard to the guages, the statements are not founded on actual measurement, as there was no scale of inches marked on either of them. The pressure of steam at the time of the explosion, was greater than was proper to use in the river, on account of the difficulty of steering, which induced him to attempt to raise the safety-valve.

Mr. Marshall also states, that his management on the night of the accident, was not at any time influenced by a desire to shorten the passage. He has been twenty years engaged in his present business, and served a regular apprenticeship in the manufacture of steam engines. The safety-valve was loaded with eighteen pounds to the square

inch. Its position is 20 feet from the boilers. On the safety-valve there were two extra weights of 50 and 28 lbs., as the valve would blow off at 8 lbs. to the square inch, with the two regular weights, owing to the lever of the safety-valve having been shortened about 2 feet. The diameter of the safety-valve is 10½ inches, and of the steam-pipes leading from the boiler, about 10 inches.

Mr. Younger concurred in every particular stated by Mr. Marshall, and thought that the explosion was not from the want of water above the flues, but was of opinion that the steam had blown the water from the legs of the boilers.

Mr. Vail's statement agrees generally with the foregoing. He states in addition, that feeling apprehensive of his personal safety, from the pressure of steam which he supposed was carried, from the motion of the engine and the management of the boat, he cautioned the firemen to that effect. He thinks the rent commenced in the legs of the boiler, near the after end.

The evidence of the two firemen, Messrs. Farnham and Bell, as also that of Mr. Seymour, was principally a corroboration of the statements of the former witnesses, and of their care in relation to the fire and water about the boiler.

The statement of Mr. Potter contained particulars of considerable importance. He was the engineer of the New England, and had run the boat every trip during the season, except the two last, when Mr. Marshall took his place, on account of his health. He usually carried from 14 to 17 inches of steam on the boilers of the New England; the engine was intended to carry from 16 to 18 inches. The three steam-guages would rise 31 or 32 inches without blowing out the mercury. Steam-boilers are now made stronger than formerly. Several years ago he ran with Captain Bunker to New Haven, with steam at only 8 inches. The extent of pressure which he thinks would be safe on the boilers of the New England, would be from 22 to 24 inches. The boat would not sail faster with 24 than with 17 inches; he has had 24 inches on the boilers several times.

When he was engineer of the Oliver Ellsworth, he usually carried from 12 to 14 inches of steam. The boilers of this boat are much the strongest and best braced of any that he has seen. He is of opinion that the under legs of

the boiler were heated, and they now appear to be annealed, and different from the outside of the boiler. The engine of the New England is about four times the power of that of the Oliver Ellsworth, which now carries from 16 to 18 inches. The McDonough carries from 12 to 14 inches. The boiler was patched twice on the middle leg of the after end; and a similar patch was put upon the other boiler. The safety-valve would commence blowing off at 18 inches, but would carry 24 inches with the same weight, and the steam blowing out at the valve.

Mr. Hall, the chief engineer of the West Point Foundry Association, furnishes the following description of the engine and boilers of the New England:—The boilers were 8 feet 4 inches wide, 8 feet high, and 15 feet long. Each boiler had two arched flues, and five circular return-flues, of 16 inches diameter. The arches, *bb*, were made of rolled copper, No. 3, wire guage: the outer shell, *a*, of No. 4, and the circular flues, *ggggg*, of No. 5. They were placed, one on each guard of the steam-boat, at the distance of about 25 feet from the engine. The boilers were braced with 7-8th inch bolts through the legs, at the distance of 9 inches, and the arches were secured to the upper parts of the boiler by strong bolts of 3-4th inch copper, with screw fastenings. The steam pipes were also of copper, and 10 or 12½ inches in diameter. The safety-valve was in diameter 10½ inches, and calculated to blow off at a pressure of 20 inches. The lever was afterwards shortened, and new weights added, after the boat commenced running.

There were four water-cocks on each boiler, to ascertain the height of the water. The lowest of these cocks was three inches from the top of the upper flues, and each cock was placed three inches above the preceding one. He had proved the boilers, and supposed they would have borne 50 pounds to the square inch. The strength of copper, as compared with iron, is as 3 to 5. Copper has been used for boilers because it suffers less from corrosion; but it is weakened by the action of heat at about 250 degrees. Iron, on the contrary, increases in strength when heated to a certain temperature. A copper boiler will bear a greater pressure when cold; but an iron boiler, if not heated beyond 450 degrees, will bear a greater pressure than when cold. He concludes by observing, that being acquainted with the abilities of Mr. Marshall, he considers him compe-

tent to take the charge of an engine in any case. Nothing of importance occurs in the evidence, either of Captain Waterman or Mr. Hayden, that has not been previously stated.

By this accident fifteen persons have died, including those found in the river.

The committee in their examination, have been particularly fortunate, in obtaining the testimony of the Engineers and firemen on duty at the time of the explosion, all of whom were providentially saved. They have also considered the various theories and conjectures put forward, to account for the disaster, which are comprised under the following heads.

1. The production of some gas, suddenly evolved in great quantity.

2. An injurious heating of the water-legs, *ddd*, forcing the water from them, and causing a rapid production of steam on its return to the heated metal.

3. A deficiency, at the time of the accident, of the proper quantity of water in the boilers.

After stating their objections to these positions, they conclude, by giving it as their unanimous opinion, *That the explosion of the steam-boat New England, was caused by the pressure of steam in the ordinary way, but accumulated to a degree of tension which the boilers were unable to sustain.*

By referring to the drawing of a cross section of the boilers, at the head of this article, our readers will be enabled to follow the descriptive part of the evidence with more accuracy.

[For the Mechanic.]

MY NOTE BOOK.—NO. I.

Messrs. Editors:—Under this caption I propose, with your permission, to introduce a variety of interesting matter in a condensed form, which, by being mostly of a practical nature, I hope will be useful to your readers.

The recipes, I shall endeavor to explain in such a manner as to be easily understood, divesting them as much as pos-

sible of those technicalities with which they generally abound, and which are a great check to their usefulness. Many of the recipes published in our most scientific works, and even those intended for the practical mechanic, are often rendered useless, by an unnecessary introduction of Latin and other foreign words.

That technical language cannot be entirely dispensed with, I am perfectly aware; but I am satisfied that a halo of mystery has been thrown over many useful articles of this nature, by authors frequently giving directions to a mechanic in the same language they would use to an apothecary. You are often told that it is particularly necessary that the gums for making varnish should be dissolved in a *Balneum Maræ*, or a *Balneum Calidum;* and without further explanation, you are left in doubt whether a *Balneum Maræ* is a glass, earthen or metal vessel, or in fact, whether it is a vessel or a liquid, a salt or a powder. Thus, having wearied yourself with vain speculations, you perhaps, by the assistance of a druggist, discover that heated sand is a *Balneum Maræ*, and that warm water constitutes what is technically called *Balneum Calidum.*

Such being the facts, I shall endeavor in 'My Note Book,' to confine myself to as plain English as possible, feeling confident that the most simple mode of expression will prove the most useful.

The Green Color of Vegetables, is produced by exposure to the atmosphere and to light. If the seeds of any vegetable be sown in a dark place, they will produce their kind, but will be entirely destitute of the beautiful green which is so pleasing to us.

During the Arctic winter spent by Captain Parry and his crew, they cultivated small sallad by means of wool, in which the seeds were sown and placed near the fire-place; but the severity of the climate having compelled them to batten down and caulk their abiding place, their sallad came up quite white. But when the season permitted the removal of a board or two, the sprouts of the sallad were observed to bend that way, and begin to turn green, which kept increasing till the whole plant had changed to its natural color.

Pyramids.—The base of the Pyramid of Cheops, named after a king of Egypt, is estimated at 720 feet, and its height at 448 feet. Its construction required so many years, and employed such a multitude of laborers, that the expenditure for garlics and onions alone for their consumption, is said to have amounted to one thousand and sixty talents, being upwards of one million of dollars.

The next in magnitude to the pyramid of Cheops, is that of Cephrenes, which is 655 feet at the base, and 398 feet in height.

Instantaneous Light Boxes, which have been recently superceded by the Lucifer matches, were made by having a small bottle of sulphuric acid, (oil of vitriol) into which a match, prepared in the following manner, being dipped, became instantly lighted.

Mix two parts of chlorate of potash with one part of fine sulphur in a cup or saucer; then dip the end of the piece of wood for the match into some very thin glue, and afterwards into the above mixture. As soon as the match is dry it will be ready for use. The sulphuric acid should be kept from the air, or it will lose its strength.

A Liquid which will appear luminous for several months, and give sufficient light to see the time by a clock or watch, may be made with a piece of phosphoros about the size of a pea, cut into very small parts, and put into a gill of clear water, and boiled in a common oil flask over a moderate fire. Pour this mixture into a phial which has just been plunged into boiling water; put in the cork, and tie a piece of wet bladder over it, that the air may be prevented from reaching the liquid.

Another Method is—Take six or eight grains of phosphoros, and one dram of camphor, and having mixed them as intimately as possible in a mortar, dissolve them in half an ounce of oil of cloves. The oil, if put into a phial, or rubbed upon the hands or face, will appear very luminous in the dark. In this state the phosphoros is quite harmless, and may be used upon the skin without danger.

Boston, Feb. 10, 1834. JUNIUS.

[From the Trans. of the London Society of Arts, &c.]

IMPROVED DRAWING INSTRUMENT.

Fig 3. Fig. 1.

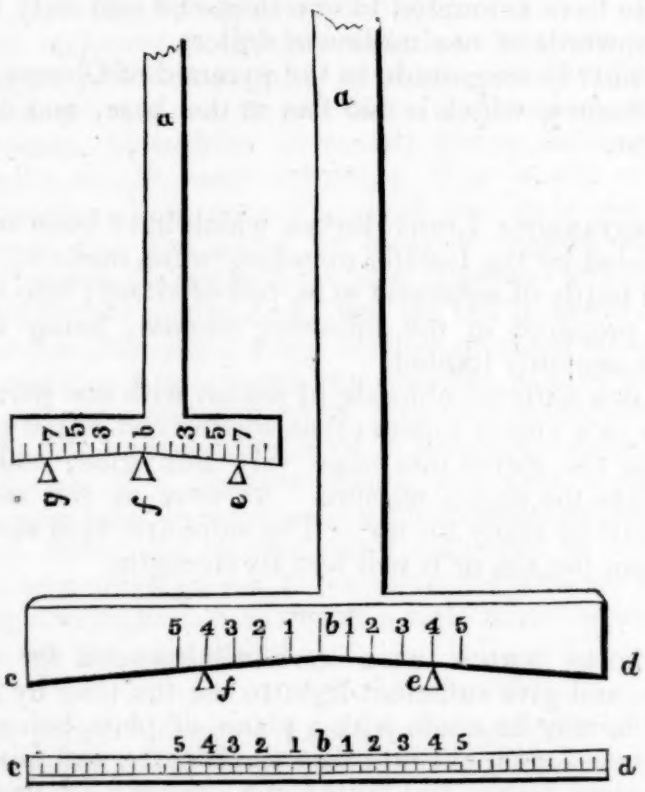


Fig. 2.

The Centro-linead is now a well known instrument. It was invented by Mr. Peter Nicholson about twenty years ago, and is described in the transactions of the Society for the encouragement of Arts, Manufactures and Commerce, in the 33d volume: * yet, to the present time, it does not appear to have occurred to any one before Mr. Shuttleworth, that fixed angles, with divisions on the sliding limbs, could be more readily applied than the instrument hitherto in use with adjusting angles.

The improvement, therefore, consists in using T squares, with longer stocks than usual, sufficiently wide to receive

* This instrument is described at page 129, Vol. 1, of this work.

at their backs the required angles, with divisions on each limb to show at what place the guide pins must be put for any given distance of the vanishing point; and as these instruments can rarely be wanted for very near points, the angle given to the first, differing about $7\frac{1}{2}°$ from a right line, ($172\frac{1}{2}°$) enables it to extend to five feet, and any less distance; the second, differing but half as much, or $3\frac{3}{4}°$, will extend to ten feet; and a third or fourth, differing still less from a right line, to any other required distance. They are formed thus: *a*, fig. 1, is the ruling blade, *b* is the angle, and *bc bd* the sliding limbs—*ef* the two pins against which they slide. Fig. 2 is the face of the limbs, to show their divisions; these divisions indicate feet, and are subdivided into inches. As the marking of these divisions impairs the surface, they should occupy but a narrow space along the middle, in order to leave a clear surface to slide against the pins; but it may be preferable to divide the upper and under surfaces, as indicated in the first figure; for then they would allow of the sliding surfaces being repaired, and they would still serve so long as the same angle was preserved.

When the two pins *ef* are placed at the two fives, they will always direct the blade to a point five feet distant; if they are placed at the fours, the blade will be directed to four feet, and so on for any less distance; for it is evident that half the distance on a fixed angle must fit a circle of half the diameter, and so for any other proportion. But here it will be seen that the pins approach each other to give shorter distances, and thereby narrow the space within which radial lines can be drawn. This, at first sight, appears to be an evil; but it is not so—for here comes in a second use of divisions, by which the instrument may at once be set to range over the whole surface of the drawing. Therefore the only fault remaining is a lessening of the base against which the blade is steadied.

I will now describe the mode of setting it. Lay the blade *a* correctly to the horizontal or other vanishing line, with the stock *cd* on the part of the board most convenient for sticking in the pins; then, at whatever distance the vanishing point is required to be from the angle *b*, read that distance among the divisions both ways from the angle *b*, and stick in the pins correctly to them; the instrument is then set and ready for use. But if the range between two pins is not sufficient, slide the angle *b* to that

pin where the increase is wanted. Suppose it is the pin *f;* then notice at what number the pin *e* stands, and place a third pin *g* at the opposite corresponding number, as in fig. 3; this will give a second portion of range, and this process may be repeated with a fourth or more pins, whereby the most ample range may be obtained.

For setting the instrument as above stated, divisions are needed only half the length of the limbs *c* and *d;* but for increasing the range they may be wanted the whole length, and also for setting it at first with a double range—for then one pin may be put on the horizontal line, and the angle *b* brought to it, with the blade correct to the line; then if 4 feet distance was wanted, place a second pin at 8 on one limb, and a third pin at 8 on the other limb; then an equal range above and below the horizon will be given.

HABITS.

'MAN IS A BUNDLE OF HABITS.'

THIS is a striking observation, and applies equally to the man, who by the maxims of prudence, makes his life a regular piece of clock-work, the undecided child of chance, who glides down to the grave with the meanders of fashionable opinion, and the prodigal, whirled in the vortex of dissipation, regulated by no other creed than the impulse of the moment.

Good habits are the regular uniform of every citizen, who is well disciplined in the school of social order. Like the garments of the children of Israel, in their journey to Canaan, they wax not old, but gain strength and beauty by wearing. They set easy to a man, while performing the part assigned him by nature and education; but serve as a restraint, when he would raise his hand, or move his foot, beyond the line of his duty.

It is better to follow an old path, that is familiar to us, though it may be a little further, than to lengthen the time by shortening the distance on a new and unfrequented rout. Nothing tends more to the happiness of youth, than the fullest confidence in those, who have the care over them. It makes labor pleasant by day, and sleep sweet by night.

There is no country that opens so wide a field for talents and ambition, as our own; and no place, where men experience a greater variety of changes in situation and employment. A frequent change of habits and opinions is the natural consequence. An exchange of a situation tolerably good, for another in itself preferable, is often an injury to him who makes it: and continual alterations of opinion, commonly terminate in no opinion at all.

These considerations make it highly important for the youth, who is impelled by genius or ambition to mix with the world, and rise through various grades of society, to take with him a complete suit of good habits, as his faithful monitors and best friends, in his tour for happiness, fame and fortune.

Begin with the mind. Train up your thoughts in the school of discipline. If they are too apt to run astray on wild and chimerical projects, or rove in the flowery fields of fancy, confine them occasionally to the systemed study of mathematics, the laborious natural philosophy, the sublime contemplations of astronomy, or the rich treasures of the historic page.

Systematic study calls in the detached thoughts, and regulates a wild and volatile imagination; and substantial knowledge enriches and adds vigor to the mind.

It is a common saying, that a youth ought to follow the bent of his genius. Before you adhere to this maxim, be sure that your genius has taken a prudent course.

Beware of extremes. While you shun the wild flights of an irregular imagination, do not become absorbed in metaphysical subtilties, or pour too intensely over mathematical demonstration.

There is a certain tone to the mind, as well as body, within which, both acquire strength, by variegated, prudent and well-timed exercise. Strain either beyond this pitch, and you destroy their constitution, or diminish their native vigor.

Regulate the bill of fare for the mind, by the same maxims of prudence and temperance, you would for the body. Never cloy the mental appetite with the unreasonable continuance of the same food, nor overburthen it with too complicated a repast. Let not an extravagant taste for variety draw you from plain, nutritive aliment; nor suffer a gormandizing appetite to overcharge the digestive powers.

A mind nurtured by the maxims of prudence, and invigorated by manly science, is armed in panoply against the dangerous train of bad habits, that arise from irregular appetites and turbulent passions. Select thoughts and chaste sentiments, when once domesticated in the heart, will exclude those of a meaner description.

Learn in season to set due bounds to passion, and say, 'hitherto shalt thou come, and no further.'

If there are some roses at the entrance of the perplexed path of gamblers, they can never be plucked without a wound from the thorn. The road is strewed with swords, daggers, shattered reputation, and empty purses. The time to desist from its dangers, and avoid the train of ill habits that accompany its wayward travellers, is the very moment you feel an inclination to pursue it.

Beware of the enticements of the bottle. If your appetite demand its intoxicating pleasures, ask it, if cold water or small beer, will not satisfy its demands? If it answer in the negative, it is a bad appetite, an evil demon: cast it from you, or starve it out—never attempt to drown it. If moistened by spirituous liquors, it will thrive at the expense of your health, credit and happiness, till it sap the life of your constitution.

If we indulge ourselves in the enjoyment of appetites to the injury of health or reputation, we are foiled by an inexorable foe. It is never safe to admit of a parley. There is no way to retrieve the loss, but by a timely retreat. In this warfare, to shun the foe, is victory.

To avoid the troublesome habit of being prolix, I will leave my pupil with his most faithful guardian, and best instructor, his own reflection.

Curious Fact.—Cut a couple of cards each into a circle of about two inches in diameter. Perforate one of these at the centre, and fix it on the top of a tube, say a common quill. Make the other card ever so little concave, and place it over the first, the orifice of the tube being thus directly under, and almost in contact with the upper card. Try to blow off the upper card. You will find it impossible. We understand that the cause that counteracts the effects at first expected at this singular phenomenon, has lately puzzled all the members of the Royal Society. A medal and a hundred guineas are said to be the reward of the successful discoverer.

OWE NO MAN.

ALTHOUGH obtaining credit may in some peculiar cases be necessary, yet it is doubtless true that in nine times out of ten, the necessity of it is occasioned by misspent time and misspent money during apprenticeship and while employed in doing journeywork. We were just about preparing a short essay on this subject, when we happened to meet with the following from the Wilksbarre Gleaner, which answered the purpose so well, that we concluded to recommend it to the serious consideration of our younger readers.

> Pray take my advice, if a fortune you'd get,
> Pay off what you owe, and then keep out of debt.

This may be bad poetry, but, depend upon it, it is excellent sense. It is an old saying, that the debtor is a slave to the creditor. If so, half the world enter into voluntary servitude. The universal rage to buy on credit, is a serious evil in this country. Many a married man is ruined by it.

Many a man goes into the store for a single article. Looking around, twenty things strike his eye; he has no money—buys on credit. Foolish man! Pay-day must come, and ten chances to one, like death, it finds you unprepared to meet it. Tell me, ye who have experienced it, did the pleasure of possessing the article bear any proportion to the pain of being called on to pay for it when you had it not in your power?

Good people, hark ye: a few rules well kept, will contribute much to your happiness and independence. Never buy what you do not really want. Never buy on credit when you can possibly do without. Take pride in being able to say, 'I owe no man.' Wives are sometimes thoughtless, daughters now and then extravagant. Many a time when neither the wife nor the daughter would willingly give a single pang to the fond father's bosom, they urge and tease him to get articles, pleasant enough to be sure to possess, but difficult for him to buy; he purchases on credit, is dunned—sued; and many an hour made wretched by their folly and imprudence. Old Robert presents his compliments to the ladies, and begs they would have the goodness to read the last eight lines once a week till they get them by heart, and then act as their own excellent dispositions will direct.

Above all things, good people, never go into debt at a tavern. To grog, to toddy, to sling, to bitters! Oh, horrid! what a bill! Never owe your shoemaker, your

tailor, your printer, your blacksmith, or laborer. Besides the bad policy of keeping in debt, it is downright injustice to those whose labor you have received all the benefits of.

How happy the man who owes not a pound,
But lays up his fifty, each year that comes round;
He fears neither constable, sheriff nor dun:
To Bank or to Justice has never to run,
His cellar well filled, and his pantry well stored,
He lives far more blest than a prince or a lord;
Then take my advice; if a fortune you 'd get,
Pay off what you owe, and then keep out of debt.

MISCELLANY.

WATER WORKS.—To supply the inhabitants of populous places with water suitable for domestic use, and the various processes in the arts, and to have always at hand a sufficient supply for extinguishing fires, is one of the noblest undertakings to which our attention can be directed; for it affects the health, life, and prosperity, of all classes and conditions of society. The poor as well as the rich, the stranger and the citizen, would all feel the benefits of such a supply. We have been led to these remarks from perusing a pamphlet, printed by order of the Common Council of this city, being a communication from our worthy Mayor, calling their attention to the subject of bringing an ample supply of pure and soft water into the City of Boston, and by a lecture before the Mechanics' Association, recently delivered by Dr. J. V. C. Smith, of this city.

We think this is a subject that should meet with the hearty concurrence of all our citizens; not because we think the water of Boston is particularly unhealthy, but because the majority cannot get a sufficient supply of what may be termed good water, and very many families find it difficult to procure an adequate supply of any kind.

The WATER WORKS erected for the supply of large cities, may be reckoned among the noblest achievements of man, both in ancient and modern times. The Romans were particularly celebrated for their aqueducts, some of which were of immense magnitude. They were built with stone, and where they passed over vallies, were supported on strong arches of masonry. In Europe most of the large towns are supplied with water by Companies. In London, the NEW RIVER WORKS have supplied the inhabitants with pure water for

nearly two centuries, at an original cost to Sir Hugh Middleton, of nearly two and a quarter millions of dollars, (500,000 pounds sterling.) The reservoir is eighty-five feet above the level of the Thames; but, to give it the necessary force, the water is raised thirty-five feet above that level, whence it rises into the second and third stories of most houses. The quantity it discharges every twenty-four hours, is 214,000 hogsheads, of sixty-three gallons each. There are, besides, the London Bridge Water Works, in which a forcing engine serves the purpose of a high level, though the water is not strained nor purified; the York Buildings Works; the East London Works—the South London—the West Middlesex, at Hammersmith and Kensington, on a grand scale, with contrivances for purifying the water; and the Grand Junction Works, at Paddington. Iron pipes have been substituted for wooden ones; and the general arrangements for the distribution of water, are such as far surpass those of any similar establishments in the different capitals of Europe.

The Fair Mount Water Works, at Philadelphia, are not only a blessing to the inhabitants, but they reflect great credit on the skill, perseverance and public spirit of their constructors. We earnestly hope that the citizens of Boston will not remain much longer in the rear of our Philadelphia brethren in this particular.

We have spoken of the state of the Water Works of London as they were several years ago. There have probably been some alterations since that time, especially at London Bridge. We intend to pursue this subject further in our next.

New Public Building.—Many of our readers will doubtless be gratified to learn by the following sketch of the proceedings of the meeting recently held at the room of the Young Men's Society, that there is a prospect of having erected in this city a new public Building, to meet the wants of the various Societies. That such an edifice would not only contribute to the convenience of the several Societies, but would be of great advantage to the citizens generally, we believe no one can doubt; and we hope that all will unite in carrying the design into effect:—

'According to previous notification, the joint Committee of several Associations (eight in number) of this city, recently met at the Room of the Boston Young Men's Society, to consider the expediency of the erection of a New Public Building, containing at least one large lecture room, and several smaller ones, such as our various Societies require for their respective purposes.

After a general discussion of the subject, during which various arguments for and against the project were presented, together with the views, so far as they were known, of the Societies represented by the gentlemen present, it was unanimously

Resolved, That the wants of the community call for the erection of a new Public Building for the purposes proposed.

A Sub-Committee was appointed to prepare a Circular, to be addressed to the different Societies of the city, stating the views of the meeting, and requesting a general expression of sentiment on the subject, and the appointment of delegates from those societies not yet represented, to attend the adjourned meeting of this Committee.

It was the general opinion, that there are already halls and committee rooms enough of an ordinary character, besides one or two excellent lecture rooms, although they are not sufficient to accommodate al the Associations of the city; that the objects to which the proposed Building would be devoted, are worthy of an edifice of a very superior order; that it should be situated in a central part of the city, so as to answer all the purposes of the great Education Resort of the metropolis; and that no steps had better be taken in relation to the subject, unless it shall be found that there is interest enough in the community to warrant the erection of such a Building.

A Committee, organized some time since, with objects similar to those of this Committee, consisting of a number of our most respectable citizens, have obtained subscriptions to a considerable amount towards the accomplishment of this object; and there is no doubt but that Committee will stand ready in the spring to cooperate in any feasible measures which the various Associations of the city may think it expedient to adopt.'

Tribute of Respect.—It gives us great pleasure to copy from the minutes of the Quarterly Meeting of the Franklin Institute, Philadelphia, the following merited tribute to our late esteemed fellow citizen, Warren Colburn.

Resolved, 'That having recently learned the decease of Warren Colburn, Esq., this Institute, in common with other friends of the Useful Arts, feel a deep sense of their bereavement, and cherish a cordial sympathy with the friends and relatives of the deceased.'

Gas Lamps of London.—The gas lamps of London alone, consume not less than thirty-eight thousand chaldrons of coal in the year. The gas pipes of the metropolis were, three years ago, of the total length of upwards of one thousand miles.—N. Y. Mirror.

To Correspondents.—We have received answers to the first and second questions in our last number; also two communications on the 'New Water Wheel;' which are deferred to our next number, as engravings are required to accompany them. We request communications on all suitable subjects; and particularly, at the present time, on the two following:—The best methods of protecting lives and property against the effects of Lightning, and explosions of Steam.

ANSWER.

In answer to a question in the last number of the Mechanic, respecting the difference of pressure sustained by two gates, the depth of water in each case being 25 feet, one of the gates being 20 feet broad at the top, and 16 feet at the bottom, and the other gate 18 feet broad throughout, I would say, if *fresh water* is used, the difference of pressure will be 19531·25 pounds; which I demonstrate as follows:

Fig. 1.

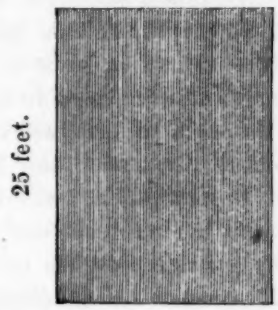


Fig. 2.

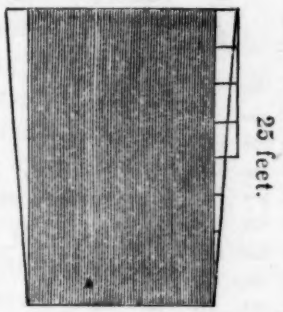


Fig. 1 represents one of the gates, whose height is 25 feet, and breadth 18 feet; if we multiply these together, the product will be 450, the number of square feet of surface exposed to the pressure of water. We must take half the height of the water for the average pressure, which is 12·5 feet. The weight of a cubic foot of fresh water is 62·5 pounds, and 12·5 times 62·5 is 781·25, the number of pounds pressure on every square foot of the gate, which, being multiplied by 450, gives 351562·5 pounds, the total pressure on this gate.

Fig. 2 represents the other gate, the height of which is 25 feet, the breadth at the top 20 feet, and at the bottom 16 feet. That portion of this gate which is 16 feet broad throughout, may be calculated in the same manner as the first gate. We shall then have 16 times 25, which

is 400, the number of square feet of surface; and this multiplied by 781·25, the average pressure, will give 312500 pounds, for the pressure on this part of the gate.

The other parts of this gate in a triangular form, diminish in breadth as the depth of the water increases; and it requires some thought to answer it correctly. Let us, for the sake of getting at the principle of the calculation, divide the height of one of these triangles into 8 equal parts, and draw lines across, as in the figure. The relative lengths of these lines will be (making the top line 8,) 8, 7, 6, 5, 4, 3, 2, 1. Now if we take any two lines equally distant, either from the ends, or from the centre of this triangle, we shall find that their united lengths will be equal to the top line. The pressure which each sustains will be the same, however they may differ in length, as will be seen by inspecting the annexed table; where the first line from the top, whose length is 7 times as great as the first line from the bottom, only sustains the same pressure; because the height of water above it is only one seventh part as great as the height of water above the other line; and we should find, that any other two lines equally distant from the centre, would sustain equal pressures; from which we may conclude, that the lower half of the figure, although much narrower, sustains the same pressure as the upper half; and may with propriety be placed by the side of it, as seen in the figure. By transposing the other triangle in the same way, and placing it by the side of the first one, we should form a parallelogram 4 feet wide, and 12·5 feet high, whose surface is 50 square feet, which being multiplied by 390·625, the average pressure in this case (being only half the average pressure in the former case) gives 19531·25 pounds for the pressure on the two triangular parts. Adding this to 312500 pounds, the pressure on the other part, it gives 332031·25 pounds, the whole pressure on the gate. The result stands thus:

Depth of water.		Relative length of the lines.		Pressure at the lines.
0	×	8	=	0
1	×	7	=	7
2	×	6	=	12
3	×	5	=	15
4	×	4	=	16
5	×	3	=	15
6	×	2	=	12
7	×	1	=	7
8	×	0	=	0

Pressure on the first gate,	= 351562·50
" on the second,	= 332031·25
Difference of pressure,	19531·25 pounds.

PHILO.

THE conclusions respecting the pressure on the triangular parts of the second gate, appears to us incorrect. We would request the author to examine it again.—EDS. MEC.